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EXECUTIVE OFFICE OF THE PRESIDENT

OFFICE OF SCIENCE AND TECHNOLOGY

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January 19, 1971

MEMORANDUM FOR

[redacted], National Security Council

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SUBJECT: NRP Support of Earth Resources

This responds to your request for information on the subject.

The NASA Earth Resources Technology Satellite Program (ERTS) is intended to be a series of satellites designed to meet Federal civil agency, State agency and industrial needs for remotely sensed data to facilitate the solution of geologic, agriculture, pollution, disaster, oceanographic and environmental problems. The intent of the ERTS program is to establish the sensor characteristic required and the data analysis techniques necessary to permit the development of an operational system or systems.

In view of the broad nature of this program and the differing levels of expertise in the various government agencies, the program has been largely shaped by NASA by what they perceived would constitute a major development, thereby assigning lower priority to meeting immediate or near-term requirements. Since the recipients of the ERTS data expect to apply it against actual problems, they tend to consider the program from an operational viewpoint, provided the system functions according to specification. This has led several agencies, especially the Department of the Interior, to request and receive funds in the FY 1970-72 time period for the purpose of equipping a center and establishing the management structure to handle the ERTS data in an operational mode.

The 1967 Woods Hole Study, sponsored by the National Academy of Science, and subsequent consideration show that photography having a ground resolution of 60 to 100 feet is required to achieve the bulk of the user agency requirements. This study also indicated that the use of multispectral techniques could alleviate some of the resolution

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EXCLUDED FROM AUTOMATIC DOWNGRADING
AND DECLASSIFICATION

requirements. If an object has a unique spectral signature, then the spacial recognition of the object would not be necessary. Therefore, it is speculated that about as much information could be derived from a multispectral system of 200 to 300 foot resolution as a black and white system at 100 foot resolution.

The Study established that repetitive coverage would be required for many of the proposed earth resources applications. In order to meet these requirements, NASA proposed a series of satellites: ERTS A and B -- electronic readout; ERTS C and D -- photographic film recovery; and ERTS E and F -- illuminator radar-laser altimeter. ERTS A and B received the bulk of the emphasis, since the other data return type systems would not efficiently meet the repetitive coverage requirements or could not be configured to record multi-spectral data. In addition, there was some expectation that declassification of KH-4 material, if approved, could provide imagery that would satisfy the ERTS C and D requirements. Also, it appeared that 100 foot ground resolution could be achieved with the RCA return beam vidicon camera. This was subsequently changed to 300 to 500 feet when RCA could only achieve 4100 line pairs instead of the originally specified 6500 and today there is some question that these figures may be optimistic for 2:1 contrast targets. Given this situation your observation that other means for meeting the earth resources requirements should be investigated seems correct.

Through the ARGO Steering Committee and other mechanisms such as the NASA/DOD Survey Applications Coordinating Committee, Federal civil agencies and NASA are familiar with the photographic capabilities of the NRP. The KH-4 system and the U-2 and SR-71 aircraft programs have been used to meet some mapping and disaster applications of the Departments of the Interior and Agriculture and the Office of Emergency Preparedness. As a result of these efforts and other studies, some of which have been sponsored by the intelligence community, it appeared that a modified KH-4 system could meet the requirements for ERTS C and D. The NRO offered NASA the option to purchase two additional KH-4 systems in January-February 1970; however, OMB declined to grant NASA the funds to do this, based on the premise that the world is already photographed by this system, therefore, additional systems are not needed and one has only to downgrade the classification and release the photography of the areas desired. However, the current 0.1 milliradian resolution restrictions of NSAM 156 prohibit release of this photography.

The DNRO has proposed to the ExCom a revision of NSAM 156 to 20 meter ground resolution now and 5 meter ground resolution by 1975, which would make the DISIC film available now and the 24-inch panoramic film available in 1975. There has as yet not been a decision and USIB is studying the matter.

The user agencies have applied aerial photography to their problems for a considerable period of time; they are equipped and have the expertise for these applications. They do not have the expertise nor the equipment to apply directly the electronic readout data to their problems in most cases. This will require that the electronic readout data will have to be converted to imagery before it can be used.

In summary, the current situation facing the Earth Resources Program is:

1. The ERTS A satellite will not meet requirements in spatial resolution for most of the proposed applications.

2. The user agencies are being organized and have requested funds to apply space data to problem areas in 1972.

3. The users have worked with aerial photography and have the expertise to apply this type of data to their operations. They have little experience and are not presently equipped to apply electronic readout data directly to many of their applications.

4. The NRP satellite frame camera systems and the aircraft camera systems can meet many of the civil requirements.

5. NSAM 156 would have to be modified along the lines proposed by DNRO to permit the application of a portion of the NRP camera systems to the civil agencies' requirements.

The NRP camera systems that are best suited to the immediate application of earth resources problems are the frame cameras on the KH-4 [redacted] These systems would require modification for color photography. The U-2 IRIS system and a U-2 equipped with a cartographic frame camera could also meet many of the user requirements on a limited scale. Additionally, the U-2 can serve as an excellent test platform for many of the proposed applications.

The KH-4 [redacted] frame cameras are primarily used for vehicle altitude determination and for defense mapping, charting and geodesy. They also serve the purpose of providing some geometric calibration to the panoramic and strip camera systems which are of prime interest to the intelligence community. 25X1

Specifically, the NRP cameras which could be modified to have the characteristics to meet the near-term earth resources requirements are:

1. The KH-4 DISIC 3-inch focal-length frame camera, which has a 4.5-inch by 4.5-inch format and covers an area 126 by 126 nm per frame at a ground resolution of 120 feet. NASA is procuring two of these cameras for use in Apollo 15 and 16 lunar mapping programs. The ITEK 24-inch optical bar panoramic cameras will also be flown [redacted] 25X1

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3. ITEK 24-inch optical bar, panoramic camera, which has a 4-inch x 2.5 foot format. This camera is designed for high altitude aircraft (requires no modification if used in aircraft).

4. ITEK 13-inch panoramic camera, which has a 70 mm x 2.5 foot format (requires no modification if used in aircraft).

These cameras are capable of providing coverage of large areas with black and white, color [redacted] photography. The color capability of the DISIC and 12-inch frame cameras is limited, due to lens speed and the filters on these cameras. It is possible, however, with some modification to acquire color photography with these cameras. 25X1

The alternatives for using NRP cameras and systems to fulfill earth resources needs are shared use of NRP frame satellite camera systems and NRP aircraft systems. For NRP satellite systems, assuming that the USIB and the NSAM 156 Committee agree to the NSAM 156 changes proposed by the DNRO, it would be possible to test the NASA lunar frame camera (item 1 above) in earth orbit. One method for doing this could be a public announcement that the NASA lunar frame camera -- in reality the KH-4 DISIC -- is to be tested in earth orbit as a

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"piggyback" on a DOD program starting this spring. Since the DISIC normally obtains photographic coverage of the United States for engineering purposes, the cost to the NRP of doing this would be the cost of processing an extra copy of this coverage. Therefore, it too could be presented as a NASA piggyback payload on a DOD program. This would require at least a modification to increase its film load if DOD and earth resources requirements were to be met without conflicts on scheduling the coverage. The cost of this modification is a one-time cost of $1.5M. The lens should be modified if color photography is desired. The cost of this is estimated to be $2M for development qualification and system integration. Since the new lens would have to fit within the current camera lens cone the recurrent cost for the modified camera would be approximately the same as for the current lens.

Excess NRP U-2C aircraft are an additional means of supporting the earth resources applications. NASA is currently negotiating for two U-2C aircraft to carry experimental payloads. If the same type of arrangement could be made, say between the Department of the Interior and DOD, then a program could be started to acquire high altitude photography of the United States on a regular basis. NRP training flights have been used for this purpose in the past. However, it would appear that this effort would be more efficient if it were managed and funded by the civil users. It is estimated that operational costs of the U-2 are approximately $200 an hour. The modification to put a stable-mount for cartographic frame cameras in the U-2 is estimated at $1M per aircraft.

It is recommended that consideration be given to the following:

1. Declassification of the current KH-4 DISIC - initially only of the U. S. and foreign countries for which we have appropriate bilateral agreements -- with appropriate cover, i.e., NASA/DOD piggyback.

2. These cameras to be credited as "piggyback" payloads with NASA/user agencies to pay for any required modification.

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3. An announcement that the NASA lunar frame camera (DISIC) will be tested in earth orbit on a DOD program this spring.

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